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UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

DEVELOPING A USED OIL RECYCLING ACTIVITY IN DEVELOPING COUNTRIES

General Considerations and Alternative Available Technologies *

Working Paper Series

No. 1

Prepared by

Division of Industrial Operations

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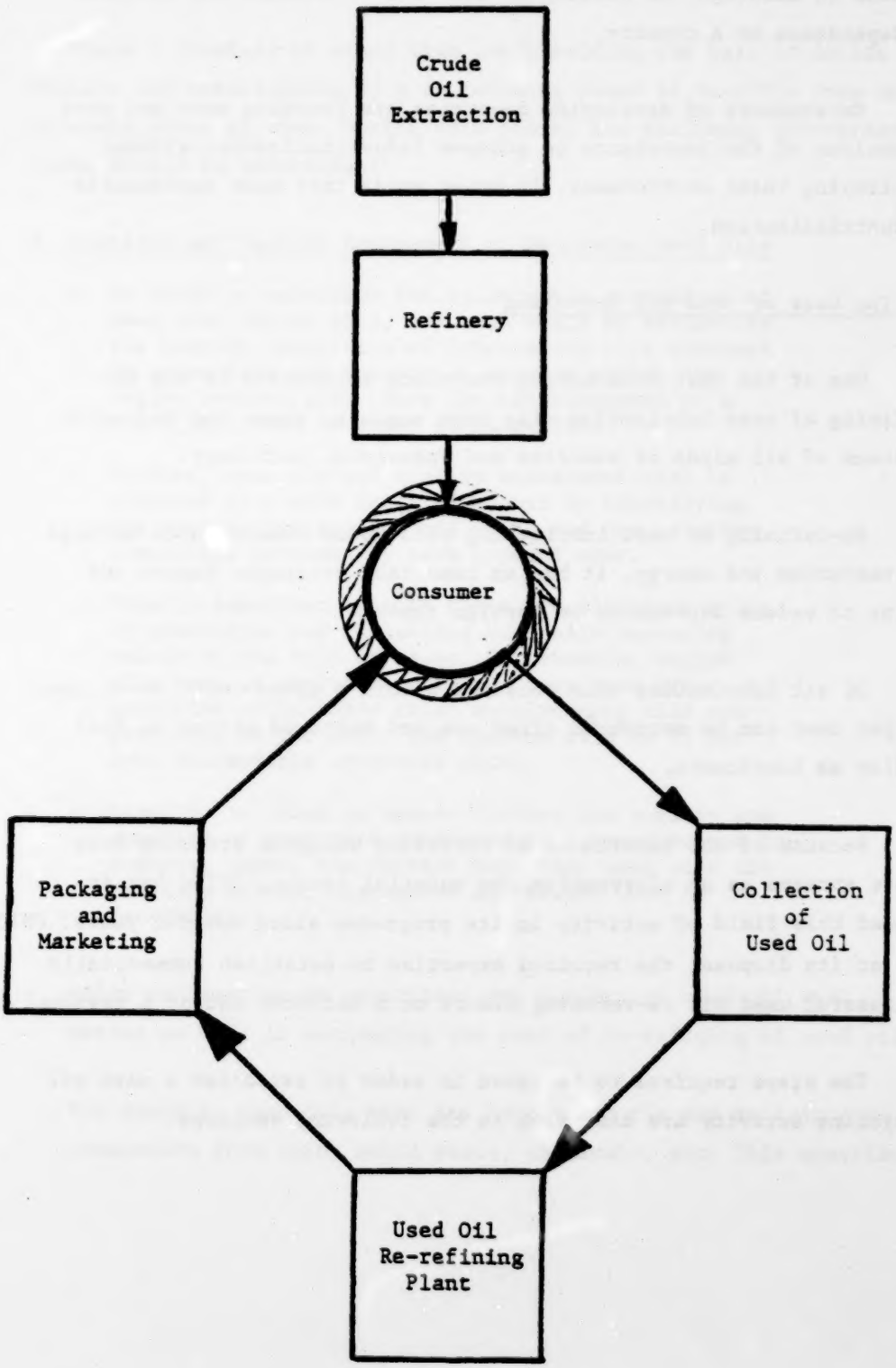
FLOW CHART I

Lubricating Oils/Used Oils/Recycled Oils Flow Chart



A. Sustainable Development

Environmental protection and recycling are today an important factor to maintain the quality of life and to enhance the economic independence of a country.

Governments of developing countries are becoming more and more conscious of the importance to achieve industrialization without destroying their environment. In other words they want sustainable industrialization.

B. The Case of Used Oil Recycling

One of the most interesting recycling activities is the re-refining of used lubricating oils from engines, gears and hydraulic systems of all kinds of vehicles and industrial machinery.

Re-refining of used lubricating oils means considerable savings of resources and energy, it has an important strategic impact and helps to reduce dependency on foreign imports.

Of all lubricating oils consumed within a given country, at least 50 per cent can be recovered after use and recycled either as fuel and/or as lubricants.

Because of the importance of recycling valuable products from waste streams as an alternative raw material source, UNIDO has included this field of activity in its programme since several years. UNIDO has at its disposal the required expertise to establish commercially successful used oil re-refining plants on a national and/or a regional level.

The steps required to be taken in order to establish a used oil recycling activity are discussed in the following sections:

1. Phase I - Prefeasibility

Assessing Whether a Used Oil Recycling Plant is a Feasible Economic Activity

Phase I consists of steps that are providing the base to decide whether the establishing of a re-refining plant is feasible from an economic point of view. During this phase, the following activities/ tasks should be undertaken:

a. Quantity and Quality Assessment of Generated Used Oils

- o In order to determine the collectable quantities of used lubricating oils, one must begin by estimating the overall quantities of lubricating oils consumed by automotive and industrial sources within the region/country/area where the establishment of a recycling plant is under consideration.

- o Further, quantity and quality assessment will be achieved in a more detailed manner by identifying the type of lubricating oil users and the relative quantities consumed by each type of user.

  This is important because there are different rates of generating and collecting used oils depending mainly on the type of usage. For example, engine oils have an approximate 63 per cent used oil potential collectable rate; metalworking oils and gear oils 80 per cent; and turbine oils an 87 per cent collectable potential rate.

- o Finally, in order to assess further the quality and quantity of used oils generated by automotive and industrial users, the current ways that used oils are handled, stored, aggregated and reused must be determined.

Above information on quantities and quality of used oil will assist as well in estimating the cost of re-refining of used oils.

For example, used oils that are handled poorly may sustain contamination from rain, solid waste, chemicals, etc. This contributes

to lower the quality of used oils and to require a more elaborate and expensive process to clean it. Moreover, extensive post-usage contamination affects the base oil yield - a fact that diminishes the economic attractiveness of a used oil recycling activity.

b. Collection System Assessment

A second and major part of the pre-feasibility phase is to determine whether there is a collection system for used oils and if not what possibilities exist to develop an efficient collection system based on the following information:

- location of sources using lubricating oils and generating used oil;
- quantities of used oils generated by individual sources;
- proposed location of used oil recycling plant.

c. Alternative Used Oil Uses

A third important pre-feasibility step is to assess the competing uses (if any) of used oils and through which channels these used oils are reaching alternative ways of reuse.

For example, used oils can be used directly as fuel and as dust suppressors on country/unpaved roads, etc. Both of these uses have serious environmental adverse effects. When used oils (especially automotive used oils) are burned as fuel without pre-cleaning, a range of metals (principally lead) is released in the atmosphere. These metals are dangerous to health. If the used oil contains gasoline or other flammable material when it is burned it may present risk of fire or explosion. Used oil applied as a dust suppressor is also dangerous to health. It may contaminate ground water sources and/or adjoining water bodies and fields.

Another competing use of used oils is reprocessing/recycling into fuels and/or lubricants. Recycling may itself generate environmental problems but these problems are controllable and newer technologies are low in pollution and their by-products are often marketable.

d. Marketing Assessment

A final but equally important step in the pre-feasibility phase is the assessment of potential local and/or export markets for recycled re-refined products.

This marketing information will enable prospective entrepreneurs to decide whether they want to produce fuel and/or lubricating oils. This decision is important because on it depends the type of technology they should utilize.

Once steps (a) through (b) are being completed, prospective entrepreneurs and/or governments are ready to proceed - if obtained information warrants the establishment of a used oil recycling activity - with Phase II.

2. Phase II - Implementation

Establishing an Integrated Used Oil Recycling System

During Phase II entrepreneurs and/or governments should proceed with the following activities/actions:

a. To determine the location and size of the plant based on information on the location of used oils generating sources and the quantities of generated used oils.

b. To develop and organize an efficient used oil collection system.

In designing a used oil collection system the following facts should be taken into consideration:

- o The efficient collection of used oil is the main pilar in the successful operation of a used oil recycling plant.
- o Used oil generating sources are dispersed.
- o Quantities of used oils generated by individual sources may be relatively small.
- o The used oil collector should have the appropriate incentives/constraints in order to bring the collected used oil to the used oil re-refining plant.

c. To devise a regulatory/incentives system that will achieve the channeling of used oil resources to desired intermediate and end-uses.

d. To estimate investment and production costs.

e. To select the type of technology to be used in recycling used oils. This decision will be based on the information available on the type of used oils collected, level and type of contamination sustained, storage, transportation, the estimated yield and the type of desired end-product. Further, technology choice will be based on the available alternatives in neutralizing, treating, disposing and/or reusing waste products generated during the recycling process.

f. To organize training courses for technical personnel of recycling used oil plants. This activity should be undertaken in co-operation with the technology transferring (if any) enterprise and/or organization.

g. To organize a marketing system for re-refined products.

These objectives and activities should be guided by available state-of-the-art surveys on used oils/recycled oils integrated systems as have been implemented in several industrial countries and some developing countries. These countries have substantial experience in recycling their used oils and their experience can be useful not only in selecting cost-effective, environmentally acceptable technologies, but in devising effective collection and regulatory frameworks. The final aim of a used oil recycling project should be to develop information based on the experience obtained in an individual country/region/plant in order to gradually develop more general guidelines that would be particularly relevant to the conditions prevailing in developing countries.

Finally, the public should be educated in order to obtain voluntary compliance in handling and disposing used oils in environmentally sound ways.

Although all implementation stages of a used oil re-refining activity are important and merit lengthier discussion, we will deal here only with some additional aspects related to the re-refining technologies.

C. Re-refining Technologies

The main treatment technologies for used lubricating oils are processing used oils into fuels and/or to re-refine them into base lubricating oils.

The burning of used oils as fuel is by far the predominant use worldwide in comparison with the re-refining into lubricants. This can be explained because of the relatively high heating value of used lubricating oils which promotes its utilization as fuel.

Furthermore, the processing of used oils as fuel requires considerably less investment than the one required for the conversion of used oils into lubricants.

In spite of these facts, several governments in both industrial and industrializing countries encourage the promotion of re-refining by devising appropriate regulatory systems and several of them by subsidizing the establishment of re-refining plants.

The promotion of used oil re-refining plants worldwide is primarily based on the following facts:

- From 1 ton of used oil, 0.6 to 0.8 tons of base lubricating stocks adequate for lubricant production are obtained. In contrast, 0.2 tons are produced from the same quantity of crude oil.
- The re-refining of used lubricating oils enables the repeated use of these oils.
- The trade balance is improved through supplementing lubricating oil imports with recycled lubricating oils.
- The burning of used lube oil contributes very little to supplement demand for energy sources due to the fact that the share of energy recoverable from spent lubricants is approximately 0.5 per cent compared to the world energy demand. 1)

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1) Dr. H. Joidl, Austroplan

Retrospectively, when thinking of used lubricating oil-refining, not only profitability should be considered, but also environmental aspects and national economic issues such as foreign exchange savings and the preservation of resources. Recycling of used oils into lubricants is an economically attractive, environmentally sound alternative to burning as fuel.

From re-refined lubricating oil base stocks several kinds of oils can be derived when blended with the appropriate additives, such as:

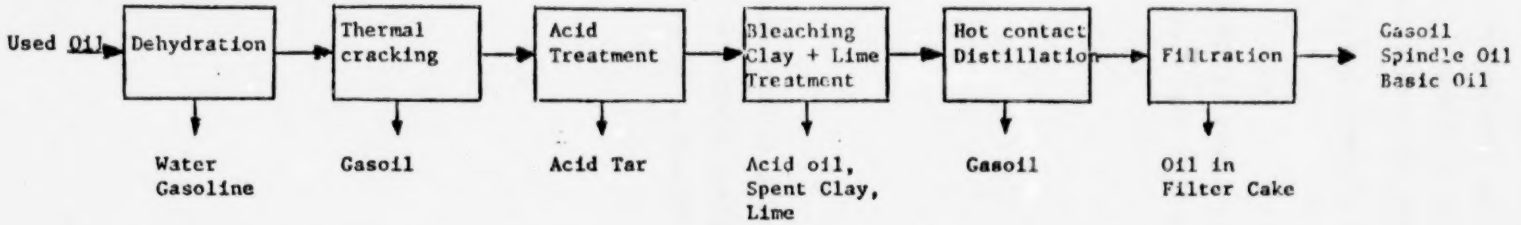
- o single and/or multigrade motor oils
- o hydraulic oils
- o gear oils
- o cutting dilutants
- o greases, etc.

There are a number of used oil processing/re-refining technologies. We are presenting here a number of these technologies which are known to be efficient both from an economic and an environmental point of view.

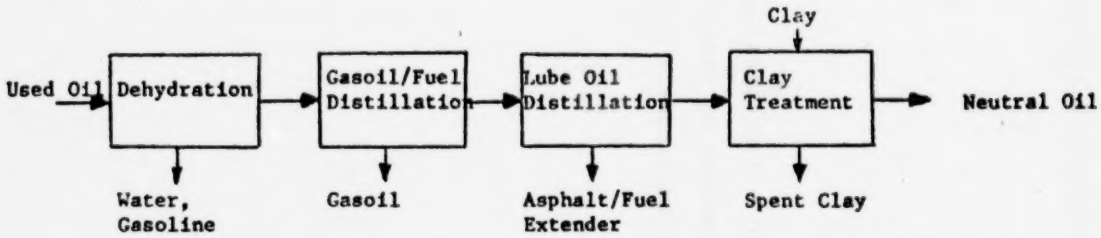
FLOW CHART II

a. ALTERNATIVE PROCESSING TECHNOLOGIES FOR LUBE OIL RE-REFINING (Meinken Process/Austroplan,
Luwa Process/Gesellschaft für Umweltschutz)

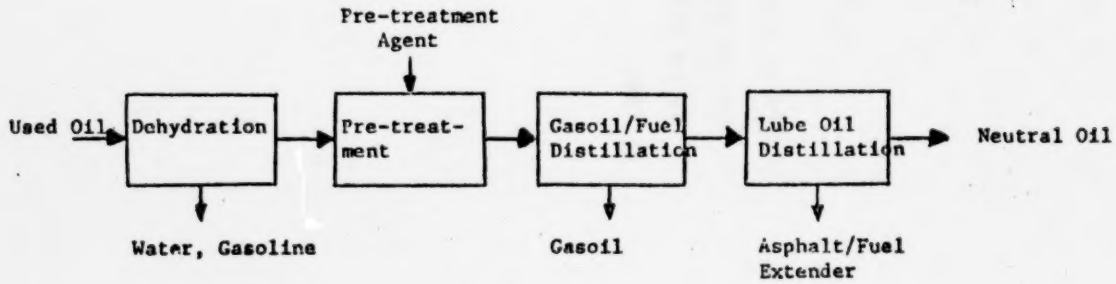
1. Acid Clay Re-refining



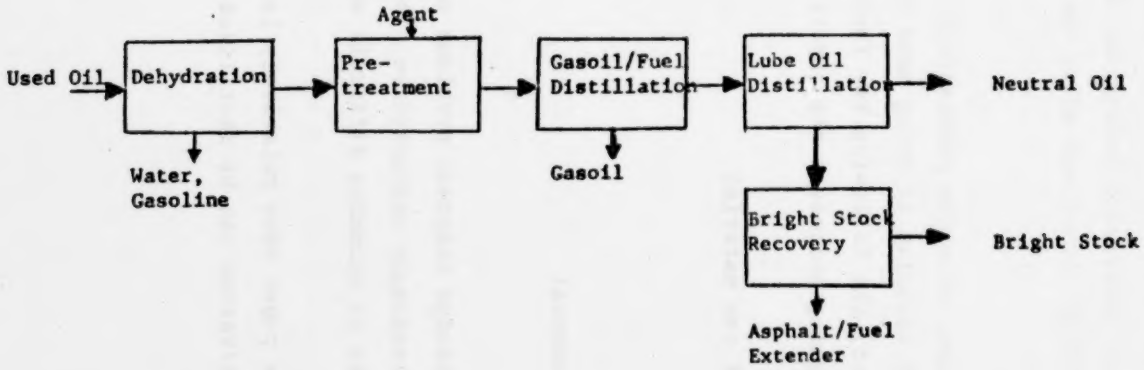
2. Thin-Film Vacuum Distillation Combined with
Conventional Clay Finishing without Acid Treatment



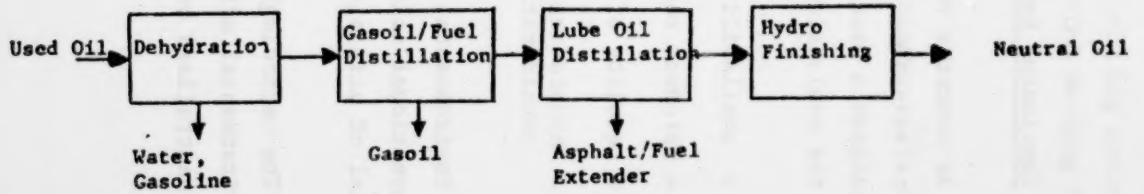
3. Total Evaporation - Evaporation of
Lube Compounds under High Vacuum



4. Total Evaporation Process with Bright Stock Recovery



5. Thin-Films Vacuum Distillation Combined with Hydrofinishing After-treatment



b. Other Available Technologies

- o Solvent extraction

  The central treatment consists of extraction of lube compounds with propane.

- o Chemical treatment (other than acid re-refining)

  The central treatment consists of precipitation of metals containing compounds with diammonium phosphate.

c. Concluding Remarks

As concerns the Technology selection, once the prefeasibility steps/assessments are completed and a decision is being made to establish a used oil re-refining plant, the following key factors in the evaluation of used oil re-refining processes are important:

- o availability and flexibility of raw material
- o product recovery yield
- o quality of used oil feedstock
- o by-products, wastes and environmental considerations/constraints

Environmental considerations and sludge disposal problems make conventional acid/clay processes increasingly unattractive. The disposal of acid sludge and clay residues is becoming difficult and costly.

The technologies described in this paper have relatively lesser environmental effects and by-products/wastes can be reutilized and/or neutralized before disposal.

UNIDO can assist in selecting the proper technology and provide the required technical expertise, organize the training of local managers, scientific/technical personnel as well as semi-skilled personnel.

As concern the organization of an efficient collection system, marketing assessment and marketing strategies for recycled/re-refined products, the development of an appropriate regulatory machinery and incentives, as well as a public information system, are necessary parts of an integrated successful used oil recycling/re-refining activity and are to be dealt with in forthcoming separate UNIDO Working Papers

Used Lube Oil Plant with a Capacity of 1000, 2000 and 3500 tpa of Dewatered Black Oil Hydrotreating-Distillation Process *

Process Yield and Utility Consumption

Assumption: Used oil feed composition containing 10% water and low boilers and 15% Gasoil

Product	Feed Compos. % wt	Recovery rate % wt	Yield % wt	Production per year t		
Used oil	110	-	-	1100	2200	3850
Water/gasoline	10	-	-	100	200	350
Dewatered black oil	100	-	-	1000	2000	3500
Gasoil/Fuel	15	14.8	99	148	296	518
Neutral oil	79	76.5	97	765	1530	2680
Asphalt/fuel extend.	5.7	7.0	-	70	140	245
Light ends	0.3	1.7	-	17	34	57
Formulated lube oil (with 12% additives)				860	1720	3000

Utilities Consumption (approx. values)		Consumption per ton recovered product
Fuel consumption	: kg	18
Cooling water	: (35°C)m^3	2
Pretreatment agent	: kg	40
Electric power	: kWh	64
Electric power installed: kWh		95

* Source: Dr. R. Movahedi, Gesellschaft für Umweltschutz

1. MANUFACTURING COST PER TON RECOVERED PRODUCT

(estimation, not binding in any case. Units taken should be checked with local conditions). The costs stated are relating to metric tons and based on actual plant data experience.

1.1. Fixed cost		Plant capacity (tpa)		
		1000	2000	3500
- personnel (3 shift operation, tot. 12 persons at US $ 4000.- p.a. each		48.-	24.-	14.-
- depreciation (5 yrs payback) - maintenance (3% of investment) - clear space requirements ($10/m^2 yr)		128.-	113.-	65.-
Subtotal		276.-	137.-	79.-

1.2. Utilities	US $/ton			
- Fuel is produced in plant	-			
- Electricity (64 kWh/t at $ 0.05/kWh	3.5			
- Water (2m^3/t at $0.25/m^3	0.5			
Subtotal	4.0	4.-	4.-	4.-

1.3. Raw material and by-products				
- Used oil (purchase and transport)	50.-			
- Pretreatment agent (ca. 5% wt added)	8.-			
Subtotal	58.-	58.-	58.-	58.-
TOTAL MANUFACTURING COST FOR NEUTRAL OIL		338.-	199.-	141.-
Optional				
- Additives for blending	105.-			
- Cans/drums for packing	100.-			
Subtotal	205.-	205.-	205.-	205.-
GRAND TOTAL		543.-	404.-	346.-
2. Wholesale price		1250.-	1250.-	1250.-
3. Gross margin		707.-	846.-	904.-

Remarks

Aforementioned figures are based on European price standards, during Spring 1984 and are subject to review at local conditions. Administration, management, taxes and distribution costs are not included.

Abstract from Preinvestment Study
Waste Lube Oil Refining Project in the Gulf Region
Acid-Clay Process *

The Mass Balance as the Base of Production Cost Calculations

This mass balance is based on the results of the laboratory analyses. Of course the actual mass balance will depend very strongly on the actual waste lube oil composition and can vary in certain limits.

Nevertheless the assumed consumption values can be expected to be average values during operation. All percentage indications are in mass %:

A	Waste lube oil input:	3000.0 t/a
	Bottom sediments + water:	4.0 %
B	Waste lube oil without water and bottom sediments:	2880.0 t/a
	H_2SO_4 consumption (8% of B):	230.0 t/a
C	Acid oil (90% of B):	2592,0 t/a
	Bleaching clay consumption (5% of C):	129.6 t/a
D	Sum of products (83% of B):	2390.4 t/a
E	Product mix of waste lube oil re-fining	
	Base oil 80% of D:	1912.4 t/a
	Spindle oil 8% of D:	191.2 t/a
	Gasoil 12% of D:	286.8 t/a
		2390.4 t/a

* Source: Dr. H. Joidl, Austroplan

Blending of products

Production of monograde oil in 200 l-drums:

1,711.2 t/a base oil mixed with 80 kg performance package base oil:

	1,721.2 t/a	base oil
	137.7 t/a	performance package
TOTAL	1,858.9 t/a	Monograde oil filled in 200-l drums (180 kg product drum)

Number of 200-l drums: 10,328 drums

Production of multigrade oil filled in 4-cans:

191.2 t/a base oil + 191.2 t/a spindle oil mixed with 90 kg performance package/t base oil + spindle oil and with 130 kg viscosity improver/t base oil + spindle oil:

191.2 t/a	base oil
191.2 t/a	spindle oil
34.4 t/a	performance package
49.7 t/a	viscosity improver
466.5 t/a	multigrade oil filled in 4 l-cans (3.6 kg product/can)

Number of 4-l cans: 129,584 cans

Survey of Material Cost for Base Lube Stock and Finished Lube Oil Production

Base: 3,000 t/a waste lube oil
1-shift operation, 2000 net production hours/year
Mass balance according to ANNEX I

Chemicals	Cost Calculation	Annual Cost Dhs/a
Sulfuric acid (650 Dhs/t/H_2SO_4) specific consumption 77 kg/t waste lube oil	650 x 0.077 x 3000	150,150
Bleaching clay (FF80 : 1700 Dhs/t) specific consumption 43 kg/t waste lube oil	1700 x 0.043 x 3000	219,300
Lime (200 Dhs/t) specific consumption 3 + 80 kg/t waste lube oil	200 x 0.083 x 3000	49,800
Ammoniak (2,500 Dhs/t) specific consumption 8 kg/t waste lube oil	2500 x 0.088 x 3000	60,000
Water chemicals Specific cost 20 Dhs/t waste lube oil		
	TOTAL CHEMICALS	539,250

Chemicals	Cost Calculation	Annual Cost Dhs/a
Auxiliary materials		
Filter paper (specific air weight of paper: 70 g/m^2, 6 Dhs/kg) specific consumption 30 m^2/day x 250 d/a = 30 x 250 x 0.07 x 6		3,150
	TOTAL AUXILIARY MATERIALS	3,150
Power and utilities		
Electric power (0.075 Dhs/kWh) specific consumption 100 kWh/t waste lube oil	100 x 0.075 x 3000	22,500
Water (6.5 Dhs/m^3) specific consumption	2.67 x 6.5 x 3000	52,065
Diesel oil (4.2 Dhs/gal corresp. to 1.1 Dhs/kg) could be provided by own production 133 kg/t waste lube oil	0.3 x 133 x 1.1 x 3000	131,670
Waste water discharged water is clean due to pruification equipment provided		
	TOTAL POWER AND UTILITIES	206,235
Total material cost for base lube stock production		748,635

Chemicals	Cost Calculation	Annual Cost Dhs/a
Additives for finishing base lube stocks		
According to ANNEX 1 the following yearly amounts of performance packages and viscosity improvers are needed:		
172,100 kg performance package à 5 Dhs/kg:		860,500
49,700 kg viscosity improver à 40 Dhs/kg:		198,800
TOTAL ADDITIVES		1,059,300
Total material cost for finished products production		1,807,935

Production Costs versus Sales Revenues

Annual input: 3,000 t/a waste lube oils

Cost item		Annual operating cost (Dhs/a)
Personnel		1,519,800
Waste lube oil supply		800,000
Total materials for finished products production		1,807,935
Products marketing		1,284,736
TOTAL OPERATING COST		5,412,471
CAPITAL COST		2,112,000
TOTAL PRODUCTION COST		7,624,471
SALES REVENUES		
Selling Price / 4 l-can (multigrade oil and monograde oil):	25 Dhs	
Selling Price / 200 l-drum (monograde oil):	900 Dhs	
Sales Revenues for Multigrade Oils		
129,584 cans/a x 25 Dhs / can:		3,239,600
Sales Revenues for Monograde Oils		
10,328 drums 10 x 900 Dhs/drum		9,295,200
TOTAL SALES REVENUES		12,534,800
GROSS PROFIT		4,910,329

Information Sources on Re-refining Processes and Economics

UNIDO is in contact with several consultants and companies around the world which have expertise in re-refining used oil. We have received material from the following companies/experts:

- Austroplan, Austria
- Gesellschaft für Umweltschutz, Austria
- Jolar Associates, USA
- Luwa Process, Switzerland
- Meinken Process, FRG
- Recon Systems, Inc., USA
- Dr. W. Irwin, USA
- National Bureau of Standards, USA
- American Petroleum Institute (API), USA

For further information please contact:
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General Considerations and Alternative Available Technologies

Corrigendum

Page 8

Paragraph 4

Line 2: after re-refining insert of used oils into lubricants

Paragraph 5

Third sub-paragraph: for oils. read oils. 1/

Delete the last sub-paragraph.

Page 9, lines 1 and 2

Substitute Conclusively, when considering the re-refining of used lubricating oils not only profitability should be taken into account, but also environmental

Page 12

Line 7: for containing compounds read and other contaminants

Line 13: delete and flexibility

Penultimate line: after effects insert than the traditional technologies

Page 14

Line 6: after boilers insert 1/

First table, first column, line 7: for Asphalt/fuel extend. read Asphalt/Distillation residues

At the bottom of the page insert

1/ Solvents like Benzin which enter the crankcase oil during motor work.

Page 18, line 9

For 42-cans read 4-litre cans

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International Symposium on "The Pharmaceutical Industry in the Arab World"

Riyadh, Saudi Arabia

INTERNATIONAL ORGANIZATIONS' ROLE IN DEVELOPMENT OF PHARMACEUTICAL INDUSTRIES IN THE ARAB WORLD *

Prepared by

Pharmaceutical Industries Unit
Chemical Industries Branch
Division of Industrial Operations

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1.0 GENERAL

Since health is a basic human need and pharmaceutical products directly affect the health of a nation, they have a greater social relevance than the products of almost any other industry. The pharmaceutical products, therefore, constitute an essential element in health care system. In view of this, the availability of pharmaceuticals assumes significance. At this juncture, it may be pertinent to look at the per capita drug consumption figures of different countries (please see annex 1). These figures show a clear demarcation between the developed and developing countries as far as per capita drug consumption is concerned. While the per capita consumption of drugs in developed countries ranged from US$ 13 to 52, the corresponding figues for developing countries ranged from US$ 0.8 to 18. This is inspite of the fact that many developing countries spend over 50 percent of their health budget on drugs. During 1982, the developing countries with 74 percent of the world's population had only 21.8 percent share of the global consumption of pharmaceuticals. In fact 75 - 80 percent of the population in developing countries have practically no access to modern drugs. It is, therefore, obvious that developing countries should formulate policies that ensure an adequate supply of reasonably priced pharmaceuticals to their population.

1.1 WORLD PHARMACEUTICAL PRODUCTION

During 1977, the share of developing countries in world production of pharmaceuticals amounted to 11.4 percent (please see Annex 2). Out of this the share of Asia was 5.6 percent while that of Africa amounted to only 0.5 percent. During 1982, the production of pharmaceuticals in developing countries was valued at US$ 15.1 billion, which corresponded to 17.8 percent of the world output, while their consumption was 21.8 percent during the same period. The imbalance was obviously made up through imports.

1.2 SPECIAL FEATURES OF THE PHARMACEUTICAL INDUSTRY TODAY

The pharmaceutical industry usually ranks first or second amongst all industries in profitability since the mid-1950s.[1] For example, in the United States and the United Kingdom, the industry as a whole earned 21 percent and 26 percent

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[1] The pharmaceutical industry and dependency in the Third World. G. Gereffi, Princeton University Press, 1983

respectively on capital employed in the latter part of the 1960s as compared with 13 percent for all manufacturing in both countries. In the 1970s, the United States Drug companies frequently earned over 50 percent profits as a percentage of networth. This situation characterizes countries such as th United States, Great Britain, Switzerland, France, the Federal Republic of Germany and Japan. These countries are also the Vanguard of innovation in the pharmaceutical industry and invested large amounts in Research and Development. Such innovation became possible in these countries due to:

- very costly experimental and clinical research programmes to develop new programs;
- strong basic chemical industry;
- an extensive university network to provide a continuing supply of well trained technicians and scientists,
- an advanced heavy industry to supply necessary equipment and machines;
- an active and competent state regulatory apparatus to ensure the quality and safety of the pharmaceuticals produced;
- large high-income consumer markets to generate the demand to buy new drugs.

The above describes the situation existing in the advanced industrialized countries but does not necessarily follow that these are the essential prerequisites for the development of the pharmaceutical industry especially in developing countries.

1.3 OVERVIEW OF THE PHARMACEUTICAL INDUSTRY IN DEVELOPING COUNTRIES

Based on the level of development of the pharmaceutical industry, developing countries can be classified into five different stages of vertical integration (please see annex 3). The countries in the first stage rely entirely on imports of pharmaceuticals in dosage form, since they have no pharmaceutical manufacturing activity. Those in the second and third stages of development import bulk drugs (pharmaceutical chemicals) and produce pharmaceuticals in dosage form. They have no facilities to produce pharmaceutical chemicals. The countries in the fourth and fifth stages have the highest degree of vertical integration. Besides producing pharmaceuticals in dosage form, they manufacture a fairly broad range of pharmaceutical chemicals from intermediates and raw materials. India, Mexico, Brazil, Argentina and Egypt are in the fifth stage. These countries are also characterised by local research and development to some extent. It is observed from annex 3 that amongst developing countries, the pharmaceutical industry is most developed in Latin

America, less advanced in Asia and the Middle East and least developed in Africa.

The degree of domestic ownership in developing countries' pharmaceutical industries is relatively low (please see annex 4). An examination of the pharmaceutical market share in 25 selected countries in 1975 shows that the domestic share held by developing countries is less than 35 percent.[2]

1.4 STATUS OF THE PHARMACEUTICAL INDUSTRY IN THE ARAB WORLD

An examination of annex 3 shows that amongst developing countries surveyed except one country, the rest of the Arab countries belong to the first three stages of development of pharmaceutical industry. The latter in most of the countries is, therefore, limited to the production of pharmacueticals in dosage form based on pharmaceutical chemicals. The number of formulation plants in these countries totalled 39 in 1977 (please see annex 5). Together these plants produced 40 percent of the pharmaceutical dosage forms consumed. However, the actual percentage of local production in individual countries varied from 0 to 86 percent.

A few of the Arab countries produce pharmaceutical chemicals required by the local pharmaceutical dosage production units. For example, El Nasr company of Egypt, produces a wide range of pharmaceutical chemicals through chemical synthesis (please see annex 6). Although El Nasr company has limited facilities for fermentation, there is no production of antibiotics based on fermentation. Tetracycline hydrochloride is produced from imported Tetracycline base; Procaine and Benzathine penicillins are produced from imported potassium penicillin. Three companies in Egypt have facilities for producing active principles of medicinal plants and have been exporting substantial quantities of the same. For example, Ammodin (xanthotoxin) is isolated from Ammi majus seeds. Besides about 60.000 litres of crude extrats are prepared from plants and these include liquorice extract, Belladonna extract, Valeriana, Gentian and Rhubarb extracts. In Egypt, aromatic industry is also well developed producing essential oils and oleoresins used in perfumery, cosmetics and food flavours (please see annex 7). Algeria has a big programme for the production of antibiotics. In Iraq there are limited fermentation facilities for the production of antibiotics and extracts from medicinal plants. A large antibiotics plant is under establishment.

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2 Ibid

2.0 PROJECTS IN THE PHARMACEUTICAL SECTOR IMPLEMENTED BY UNIDO IN THE ARAB COUNTRIES

Based on an agreement with the Arab company for Drug Industries and Medical Appliances (ACDIMA) a team of seventeen international experts was assembled by UNIDO in 1977 to survey the situation in different countries and to prepare in detail a production programme for the production of drugs, packaging materials and medical appliances. This led to the preparation of an integrated production plan for the Arab Pharmaceutical Industry.[3] This plan contained recommendations outlining the appropriate measures to be undertaken by ACDIMA in the short term as well as the long term for the implementation of the above plan. Additional survey and feasibility studies carried out during 1977-1984 are indicated in annex 8.

3.0 DEVELOPMENT OF THE PHARMACEUTICAL INDUSTRY IN DEVELOPING COUNTRIES - SPECIAL CONSIDERATIONS

It is but natural that the economic viability of the pharmaceutical industry in developing countries is looked upon like any other industry or for that matter like the pharmaceutical industry in the advanced industrialised countries. As indicated in para 1.2 above, the pharmaceutical industry in developed countries is characterised by large market, elaborate research and development complex, availability of highly skilled technicians and scientists, existence of a strong chemical and machine fabricating industries etc, etc... Since, most of developing countries are characterised by the absence of these very factors, one is tempted to conclude that the pharmaceutical industry in developing countries is unlikely to be economically viable. Finally, it is argued that pharmaceuticals are available on the international market at competitive prices and it is, therefore, more economical to import rather than take up local production. However, there are other more compelling factors, which have to be taken into account while dealing with the development of pharmaceutical industry in developing countries and these are discussed briefly below:

3.1 SOCIAL BENEFITS

As indicated earlier, since pharmaceuticals directly affect the health of a nation, they have greater social relevance than most other industrial products. Modern medicines have helped to control several diseases that once were the leading causes of death, such as tuberculosis, pneumonia, cholera, typoid, smallpox, polio,

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[3] Production plan for the Arab Pharmaceutical Industry in selected Arab countries UNIDO/IOD/299, 1978.

cardio-vascular diseases and to a limited extent cancer. The medicines thus have helped prolong and improve the quality of life for millions of people throughout the world. When one recognises that only 20-25 percent of the population in developing countries has access to modern medicines, there is an urgent need to augment the supplyof pharmaceuticals to reach a larger segment of population.

3.2 SELF RELIANCE

As in the case of food, self reliance is vital in the case of pharmaceuticals. Two recent instances highlight the importance of self reliance. During 1983, an earth quake occured in a least developed country and a UNIDO assisted pilot plant was the only facility available in the country which worked round the clock to supply essential drugs. Imports would have taken not less than a week and this would have meant loss of several lives. In another developing country, an emergency situation required intravenous fluids immediately and it took five days to import from Europe and then it was too late. In view of this, one cannot consider pharmaceutical industry development in economic terms alone.

3.3 COST-EFFECTIVENESS OF PHARMACEUTICALS

Recent studies relating to the cost-effectiveness of vaccines, beta blockers and other drugs showed that drugs are an economical form of medical therapy and that they can substantially reduce overall health-care costs.[4] When one recognizes that nearly 50 percent of the health budget in several developing countries is accounted by drugs, their cost-effectiveness assumes greater significance. For example, the study referred to above showed that the benefit-cost ratio for measles immunization in Yaoundé, Cameroon was 33:1. Similar observations were made in the case of antibiotics, beta blockers and anti-ulcer medicines where in the cost-effectiveness was considerable.

3.4 OTHER BENEFITS

Other benefits derived from the establishment of the pharmaceutical industry in developing countries are employment apportunities, manpower development, export possibilities, economizing on foreign exchange through local production and minimizing imports, utilization of natural resources and local raw materials and development of ancillary industries etc, etc....

In the light of above, it is obvious that there are several special considerations which favour the development of the pharmaceutical industry in developing countries.

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[4] Cost-effectiveness of pharmaceuticals. Pharmaceutical Manufacturers Association, 1984, Washington D.C, U.S.A.

4.0 STRATEGY FOR THE DEVELOPMENT OF THE PHARMACEUTICAL INDUSTRY IN THE ARAB WORLD

From the foregoing, it is obvious that the development of Pharmaceutical Industry has considerable relevance to the situation in the Arab World. The integrated development of this industry in this region would create vital and strategic health-related industries having direct impact on the socio-economic development of one of the most important regions of the world. Such a development can be achieved through a concerted action in different areas as described below briefly:

4.1 PRODUCTION OF PAHRMACEUTICALS IN DOSAGE FORM

As indicated earlier in para 1.4, the existing formulation plants in the Arab countries produce about 50 percent of their needs. The technology involved in the production of pharmaceuticals in dosage form is relatively simple and is well diffused. This type of industry is also characterized by licencing arrangements, foreign subsidiaries and joint ventures. In view of this, it is appropriate to expand the capacity of pharmaceutical dosage form production. A projection based on 1977 production showed that approximately 35 formulation plants should be built additionally to meet 44 percent of the Arab countries' needs by 1985.[5] The new plants should also cover large volume parenterals and small volume parenterals and veterinary formulations. It is also desirable that the location of new plants is complementary to improving existing plants. The Second UNIDO Consultation on the Pharmaceutical Industry in 1983 concluded that where a country decided to establish or expand manufacturing of formulation capacity of specific products, it was appropriate for UNIDO to make available advice and assistance in the selection and acquisition of technologies, preparation of feasibility studies, obtaining of investment finance and, more generally, establishment of manufacturing capacity including the training of manpower.[6] To promote industrialization in the pharmaceutical sector, UNIDO has prepared a series of technical profiles offering guidance to developing countries in the establishment of units for production of phamaceutical dosage forms.[7] The UNIDO Directory of sources of supply assists developing countries in locating suitable sources of supply for the pharmaceutical industry.[8]

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5 Production Plan for the Arab Pharmaceutical industry in selected Arab Countries Ibid.

6 Second Consultation on the Pharmaceutical Industry. UNIDO/ID/311, 1983.

7 Technical profiles for production of pharmaceutical dosage forms, NIDO/IO/WG. 393/4, 1983.

8 Directory of Sources of supply of 26 essential drugs, their chemical intermediates and some raw materials, UNIDO/ID/WG.393/2, 1983.

While planning production, it is desirable to select a product mix which renders the operations economically viable. It is heartening to note that considerable emphasis is being laid on GMP and Quality Assurance as is evident from the formulations units established in the region recently. Here is an area where technical co-operation between the Arab countries is possible and should be encouraged.

4.2 MANUFACTURE OF PHARMACEUTICAL CHEMICALS

Unlike in the case of production of pharmaceuticals in dosage form, the technology in the case of manufacture of pharmaceutical chemicals is rather sophisticated and is held by a limited number of technology holders. This is one of the reasons why very few developing countries have been able to make some headway in the area of manufacture of pharmaceutical chemicals. The availability, pricing and transfer of technology for bulk drugs formed one of the major issues of both the UNIDO consultations on the pharmaceutical industry held in 1980 and 1983 respectively.[9] The First Consultation recommended that mutually acceptable transfers of technology should be facilated through UNIDO providing reference information relevant to the transfer of technology, including technical aspects, such as level of production, magnitude of investments, inputs, infrastructure etc.. whichcould be a significant aid to individual developing countries in bilateral negotiations for transfer of technology. Subsequently UNIDO received certain offers of technology for the production of intermediates and bulk drugs. The second consultation recommended that in respect of offers of such technology, UNIDO should, in co-operation with technology holders, prepare feasibility studies at the request of interested countries. It can be seen from above that, UNIDO has been assigned an important role to facilitate the transfer of technology.

4.2.1 PHARMACEUTICAL CHEMICALS BASED ON FERMENTATION

The "wonder drug" penicillin developed during World War II led to the discovery of several life saving antibiotics. The antibiotic group constitutes the most important therapeutic group amongst drugs consumed in many of the developing countries and accounts for about 25 percent pf drug consumption. Except for a few, most of the developing countries entirely depend on imports of antibiotics in bulk as well as formulations to meet their demands. The recent advances in biotechnology and genetics engineering have opened up new venues for production of pharmaceutical products, vaccines, etc... In view of this, it is appropriate that the Arab countries take up and expand the manufacture of pharmaceutical chemicals based on

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9 First Consultation on the Pharmaceutical Industry, UNIDO/ID/259, 1980
Second Consultation on the Pharmaceutical Industry, Ibid

fermentation. As indicated earlier, some beginning was made in Egypt and Iraq during the sixties but this has not materialized significantly. Recently, a large antibiotics manufacturing complex has been established in Algeria. Another large complex is under establishment in Iraq. These plants could serve as nuclei for transfer of technology and training to other countries in the Arab world to facilitate the establishment of antibiotics plants in their respective countries.

4.2.2 PHARMACEUTICAL CHEMICALS BASED ON CHEMICAL SYNTHESIS - MULTI PURPOSE PILOT PLANT

An analysis of the Arab market reveals that many of the drugs are consumed in quantities not large enough to render the establishment of a seperate production unit economically viable. In view of this, it is appropriate to utilize the available facilities in Egypt and Iraq fully and to expand. At the same time, it is desirable to build a multi purpose pilot plant for the production of a group of synthetic drugs. Such a plant will facilitate the transfer of technology and its adaptation based on which single line production units or multi purpose plants to manufacture a group of drugs depending on their viability could be established. Multi purpose pilot plants of this type are being established under the auspices of UNIDO/UNDP in Cuba and Iran. These pilot plants will also facilitate training.[10]

Apart from above, with the development of petro-chemical industry in the Arab World, a number of chemicals are available, which could be used as such in the manufacture of synthetic drugs or in the production of intermediates required for the manufacture of such drugs. Thus, the establishment of facilities for the manufacture of pharmaceutical chemicals through chemical synthesis will facilitate the utilization of products from the petro-chemical industry.

4.2.3 PHARMACEUTICALS BASED ON MEDICINAL PLANTS

The Arab countries are very rich in plant resources, which can be exploited for industrial purposes. Because of wide variety of climatic and soil conditions, all types of medicinal plants of tropical, sub-tropical, temperate and mediterranean region can profitably be cultivated in one or the other Arab countries.

A close study of the available information on medicinal plants indicates that 21 species of medicinal plants occur in 13 Arab countries. Amongst these, according to scientific survey carried out, six of the plants are available in sizeable quantities from wild sources which can be used as raw material for a modern pharmaceutical industry. In view of this, an organization can be set up to process available

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[10] Multi purpose plant for production of UNIDO essential drugs based on raw material and intermediates, UNIDO/WG.393/18

medicinal plants as well as for producing such plants on a commercial scale. Simultaneously, cultivation on a scientific basis of medicinal plants should be undertaken. Applied research and development work should also be carried out to produce important drugs from medicinal plants for internal consumption. Analysis of the available information shows that phyto chemicals and crude extracts from medicinal plants are used extensively in different Arab countries. Nearly 20 pure chemicals and more than 80 crude extracts are found to be used in formulations marketed in the Arab countries, This shows that there is a ready market for local production (please see annexes 9 & 10). The Second Consultation on the Pharmaceutical Industry has given a mandate to UNIDO to intensify its programme in the area of medicinal plants.[11]

4.2.4 PRODUCTION OF BIOLOGICALS

The production of biologicals for the enhancement of preventive measures in the Arab countries assumes significance considering the efforts being made in this region toward Health care. Certain facilities and infrastructure in this sector already exist in the Arab world, for example, in Jordan, Egypt and Iran Existing facilities could be expanded to augment production as well as widen the range. New facilities could be established to meet the increasing demand. UNIDO has launched a programme on Industrial Utilization of Biologicals (IPB) and an Advisory Panel on Preventive Medicine has been established with high level representatives from both industry and government to guide the above programme. The Second Consultation on the Pharmaceutical Industry has given a mandate to UNIDO to undertake a wide ranging programme in the area of biologicals.[12]

4.3 THE STRENTHENING OF CAPABILITIES OF NATIONAL INSTITUTIONS IN THE AREA OF RESEARCH AND DEVELOPMENT

As indicated earlier, the pharmaceutical industry in the Arab World is mostly confined to the production of pharmaceuticals in dosage form (formulations) based on imported pharmaceutical chemicals. Technology for the production of formulations is relatively simpler and is well diffused. However, technology for the manufacture of pharmaceutical chemicals is more sophisticated and there are a limited number of technology holders from whom such technology is available. In view of this the development of the pharmaceutical industry in the Arab countries; as in the case of other developing countries depends to a considerable extent on the acquisition, adaptation and development of technology.

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11 Ibid

12 Ibid

4.3.1 PHARMACEUTICAL INDUSTRY RESEARCH AND DEVELOPMENT CENTRE

For the reasons mentioned in para 4.3 above, it would be appropriate to establish a Regional Pharmaceutical Industry Development Centre. Such a centre will have facilities in different disciplines for adaptation of technology, product development, engineering design and training. The organization set up of such a centre is shown in annex 11. This centre will also provide support to the existing pharmaceutical industry. Based on the technology and skills developed in the centre, facilities could be established for industrial scale production of pharmaceuticals in the Arab countries.

4.3.2 CENTRE FOR RESEARCH AND DEVELOPMENT IN BIOTECHNOLOGY AND GENETIC ENGINEERING

As indicated in para 4.2.1 above, the use of living organisms or their components in industrial processes - biotechnology has made significant progress with the development of genetic engineering. The latter enables the manipulation of the genetic material of the micro-organisms to produce the desired characteristics or abilities. Within the last eight years, this development has led to several practical applications, such as: microbial production of himan insulin, growth hormones and interferons. Human insulin is currently being marketed in Europe and will be released soon in the U.S.A. Rapid progress is also being achieved in the area of vaccines, blood replacement products and immune stimulating products. Similar products meant for veterinary use can have significant impact on meat production. This field has also application in the area of agriculture.

In view of the immense possibilities and potentials in the area of biotechnology and genetic engineering, it is appropriate that an important sub-region such as the Arab world should have a centre. A sub-regional centre for Research and Development of Biotechnology and Genetic Engineering is being established in Mexico, under the auspices of UNDP/UNIDO and the government of Mexico. [13]

5.0 ANCILLARY INDUSTRIES

The pharmaceutical industry in many of the Arab countries is limited by the lack of local industry for the production of miscellaneous items such as glass and plastic containers and other packaging materials. The integrated development of the pharmaceutical industry should, therefore, include the establishement of ancillary industries to meet the requirements on a regional basis. It is therefore, appropriate

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13 DP/RLA/83/003 Centre for Research and Development in Biotechnology and genetics for Pharmaceutical Products.

that pharmaceutical glass container projects, empty gelatin capsules projects etc.. should be set up paralelly with the development of the pharmaceutical Industry in the Arab countries. It is heartening to note that projects for the production of pharmaceutical glass and pharmaceutical capsules have been taken up in Egypt and feasibility study for a pharmaceutical glass container project has been carried out in Syria.

6.0 TECHNICAL COOPERATION AMONGST DEVELOPING COUNTRIES (TCDC)

In view of the complex technology involved in the production of pharmaceutical chemicals and the limited number of sources available for the acquisition of such technology, TCDC assumes significance. Fortunately, some of the developing countries in the Arab world as well as outside are relatively more "advanced" than others in the technological field and they would be in a position to assist sister developing countries. As already mentioned, a multi purpose pilot plant for the production of 15 pharmaceutical chemicals through chemical synthesis is at an advanced stage of establishment in Cuba with technical know-how from India. Similar possibilities exist within the Arab world itself.

ANNEX 1

Per Capita Drug Comsumption of Selected Countries

(dollars of the period)

	Year	Per capita drug consumption (in US$)	Population (in millions)
Developing Countries			
Algeria	1976	8.2	16.23
Afghanistan	1976	1.2	14.00
Argentina	1975	18.0	25.38
Bangladesh	1976	0.9	80.40
Brazil	1976	12.0	109.96
Chad	1977	0.8	4.2
China	1975		822.8
Egypt	1977	5.5	38.08
Ethiopia	1978	0.8	2.86
Guinea	1977	1.7	5.7
India	1977	1.6	620.44
Indonesia	1976	1.8	135.19
Iran	1977	14	34.3
Korea, Rep of	1977	14	35.96
Libyan Arab Jamahriya	1975	9.9	2.44
Malaysia	1977	2.5	12.65
Mexico	1976	11.6	62.05
Nigeria	1977	2.75	77.05
Pakistan	1976	1.3	71.30
Peru	1975	9.6	15.38
Sudan	1977	5.6	15.8
Thailand	1976	5.75	42.96
Tanzania	1976	1.3	15.1
Turkey	1975	4.1	40.1
Developed Countries			
Austria	1975	26	7.5
Belgium	1975	42	9.8
Canada	1976	28	23.18
Denmark	1976	28	5.07

Annex 1 (continued)

Country	Year	Per capita drug consumption (in US$)	Population (in millions)
Developed Countries (Cont.)			
Finland	1976	36	4.73
France	1976	50	52.92
FR Germany	1976	52	62.00
Greece	1976	24	9.13
Ireland	1976	13	3.16
Italy	1976	34	56.19
Japan	1976	41	112.77
Netherlands	1976	26	13.77
Norway	1976	24	4.03
Spain	1976	36	35.70
Sweden	1975	36	8.22
Switzerland	1975	35	6.41
U.K	1976	18	56.07
U.S.A	1976	33	215.12
Centrally Planned			
Czechoslovakia	1975	27	14.80
Hungary	1975	28	10.54
Poland	1975	14	34.02
USSR	1975	9	254.39

Source: Population data from World Bank Atlas 1977
UNIDO case studies on developing countries and ACDIMA: "Arab Pharmaceutical Consumption and Industries".

Annex 2

Production of Pharmaceuticals
and share by regions
(1977)

	US$ 10^6	% Share of Production
Developed Countries		
Market Economies		
North America	14 369	25.14
Western Europe	21 196	37.09
Others	9 247	16.18
Centrally Planned Economies		
Eastern Europe	12 331	21.58
Total Developed Countries	57 143	88.55
Developing Countries		
Africa	364	0.56
Asia (excluding China)	3 621	5.61
Latin America	3 397	5.26
Total Developing Countries	7 382	11.43
World Total	64 525	

Source: UNIDO

Annex 3

Levels of Development of the Pharmaceutical Industry in Third World Countries, 1979

Stage of Pharmaceutical Production	Africa	Latin America	Asia	Middle East
Group 1: Countries that have no manufacturing facilities and are therefore dependent upon imported pharmaceuticals in their finished form. In many of these countries there is insufficient trained personnel, limited public health services, and poor distribution channels.	Burundi Central African Republic Chad Lesotho Rwanda Sierra Leone Somalia Swaziland Togo Uganda Zambia	Honduras	Bhutan Mongolia	Yemen
Group 2: Countries that have started to repack formulated drugs and process bulk drugs into dosage forms.	Ivory Coast Kenya Madagascar Senegal Sudan Tanzania	Bolivia Costa Rica El Salvador Guatemala Haiti Trinidad & Tobago	Afghanistan Burma Malaysia Nepal Sri Lanka Vietnam	Jordan
Group 3: Countries that process a broad range of bulk drugs into dosage forms and manufacture some simple drugs from intermediates.	Algeria Ghana Morocco Nigeria Tunisia	Colombia Ecuador Peru	Bangladesh Indonesia Philippines Singapore Thailand	Iran Iraq Syria
Group 4: Countries that produce a broad range of bulk drugs, from intermediates and manufacture some intermediates using locally produced chemicals.		Chile Venezuela	Pakistan Republic of Korea Turkey	
Group 5: Countries that manufacture most of the intermediates required for the pharmaceutical industry and undertake local research on the development of products and manufacturing processes.	Egypt	Argentina Brazil Mexico	India	

Sources: United Nations Industrial Development Organization, 1978; revised and amended in IMS world Publication Ltd, 1979.

Annex 4

Pharmaceutical Market Shares Held by Domestic and Foreign Firms in Twenty--Five Selected Countries, 1975 (by percentages)

Country	Domestic Share	Foreign Share
Saudia Arabia	0	100
Nigeria	3	97
Belgium	10	90
Venezuela	12	88
Canada	15	85
Australia	15	85
Brazil	15	85
Indonesia	15	85
Mexico	18	82
India	25	75
Iran	25	75
Argentina	30	70
Philippines	35	65
[a]Italy	40	60
[a]Netherlands	40	60
South Africa	40	60
[a]United Kindgom	40	60
[a]Sweden	50	50
[a]France	55	45
Spain	55	45
[a]Germany, Federal Republic of	65	35
[a]Switzerland	72	28
[a]United States	85	15
[a]Japan	87	13
USSR	100	0

Source: Schaumann, 1976:

[a]The home country of at least one of the major pharmaceutical transnational corporations.

The Pharmaceutical Industry and dependency in the Third World, Ibid.

Annex 5

Number of Formulation Plants in Arab Countries and Percentage of Local Consumption produced by these Plants*

Country	No. of Plants in production in 1977	% of local consumption produced
Morocco	15	75
Egypt	10	86
Algeria	3	35
Sudan	3	15
Syrian Arab Republic	3	15
Iraq	1	30
Tunisia	1	25
Jordan	1	20
Kuwait	1	10
Libyan Arab Jamahiriya	0	7
Saudi Arabia	1	3
Yemen	0	0 (1 underway)
United Arab Emirates	0	0
	39	

The total number of plants in operation in the Arab countries = 39. These plants produced 44% of the pharmaceutical dosage units concumed in the Arab countries.

* The information was supplied by ACDIMA personnel.

Annex 6

Production of Synthetic Drugs at El Nasr Co., 1977

(Egypt)

Synthetic bulk products of El Nasr Pharmaceutical Company (excluding intermediates) which have been in past years or are presently manufactured:

Product	Prodn. target 1977 (metric tons per annum)
Sulfanilamide	15
Sulfacetamide	75
Sulfacetamide-Na	20
Sulfaguanidine	75
Sulfadimidine	65
Sulfadimidine-Na	30
Chloramphenicol	12
Chloramphenical palmitate	2
Chloramphenicol stearate	-
Tolbutamide	40
PAS	-
Salicylic acid	10 1)
Na-salicylate	15
Methylsalicylate	-
Salicylamide	50
Acetylsalicylic acid	400
Ca-benzamidosalicylate	60
Ferric ammonium citrate	-
Diiodohydroxyquinoline	-

1) sublimed

Annex 7

Production of Important Essential Oils in Egypt (1977)

Serial No.	Name of the Oil	Area under Cultivation in Feddan	Estimated production of oil in Tons
1.	Geranium oil	11.000	210.00
2.	Jasmine concrete	2876	11.54
3.*	Peppermint and Spearmint oil	446	2.0
4.	French Basil oil	75	1.50
5.	Bitter orange oil	80	0.50
6.	Neroli oil	80	0.50
7.	Majoram oil, Rosemary oil, Rose concrete, Aniseedoil, Fennel oil, Dill oil, Thyme oil, Cumin oil & Garlic oil		small quantities

* Only a part of Peppermint herb is distilled for oil and a major portion is exported as dried herb for medicinal tea.

Annex 8

Pharmaceutical Industry Projects implemented by UNIDO in Arab Countries during 1977-1984

1. UNIDO/IOD/299 - Production Plan for the Arab Pharmaceutical Industry in selected Arab Countries.
2. UNIDO/IOD/155 - Assistance in the establishment of Pharmaceutical Industries, Yemen Arab Republic.
3. UNIDO/IOD/160 - Rapport sur l'Industrie Pharmaceutique en Algérie.
4. AR/SYR/82/001 - Pharmaceutical glass container project, Syria.
5. SI/MOR/82/801 - Conseillers dans le domaine Pharmaceutique, Morocco.
6. UC/PLO/83/066 - A Study of the Pharmaceutical Industry in the West Bank and Gaza strip.
7. SI/RAB/83/801 - Pharmaceutical Industry Advisory Services, ACDIMA.
8. UC/RAF/83/088 - Programme for production of vaccines in Africa - Algeria.

Annex 9

Medicinal Plants available in large quantities in Arab Countries

Serial No.	Name of the plant	Active constituents	Location & source	Quantity* in metric/tons
1.	Liquorice (Glycyrrhiza Glabra)	Glycyrrhizitic Acid Liquorice extract	Iraq, Syrian A.R (wild)	7728.00
2.	Senna-podsand leaves (Cassia acutifalia)	Calcium sennosides	Sudan (wild)	1751.00
3.	Gum Arabic (Acacia senegal)	B.P. grade Gum Arabic	Sudan (wild)	28347.00
4.	Ammi majus	Xanthotoxin (Ammodin)	Egypt (wild & cultivated)	100.00
5.	Ammi visnaga	Khellin	Egypt (wild & cultivated)	200.00
6.	Henbane (Hyoscymus muticus)	Hyoscine, Hyoscymine, Atropine	Egypt Sudan (wild)	Exact figure not known.

* estimate based on export of these raw materials in 1975 (Bureau of Statistics Egypt, Sudan, Syrian Arab Republic, Iraq).

Chammomile. (Matricaria Chammomila) is cultivated on large scale in Fgypt, but the dried flowers are exported to Europe, and there is no scope for processing this material.

Annex 10

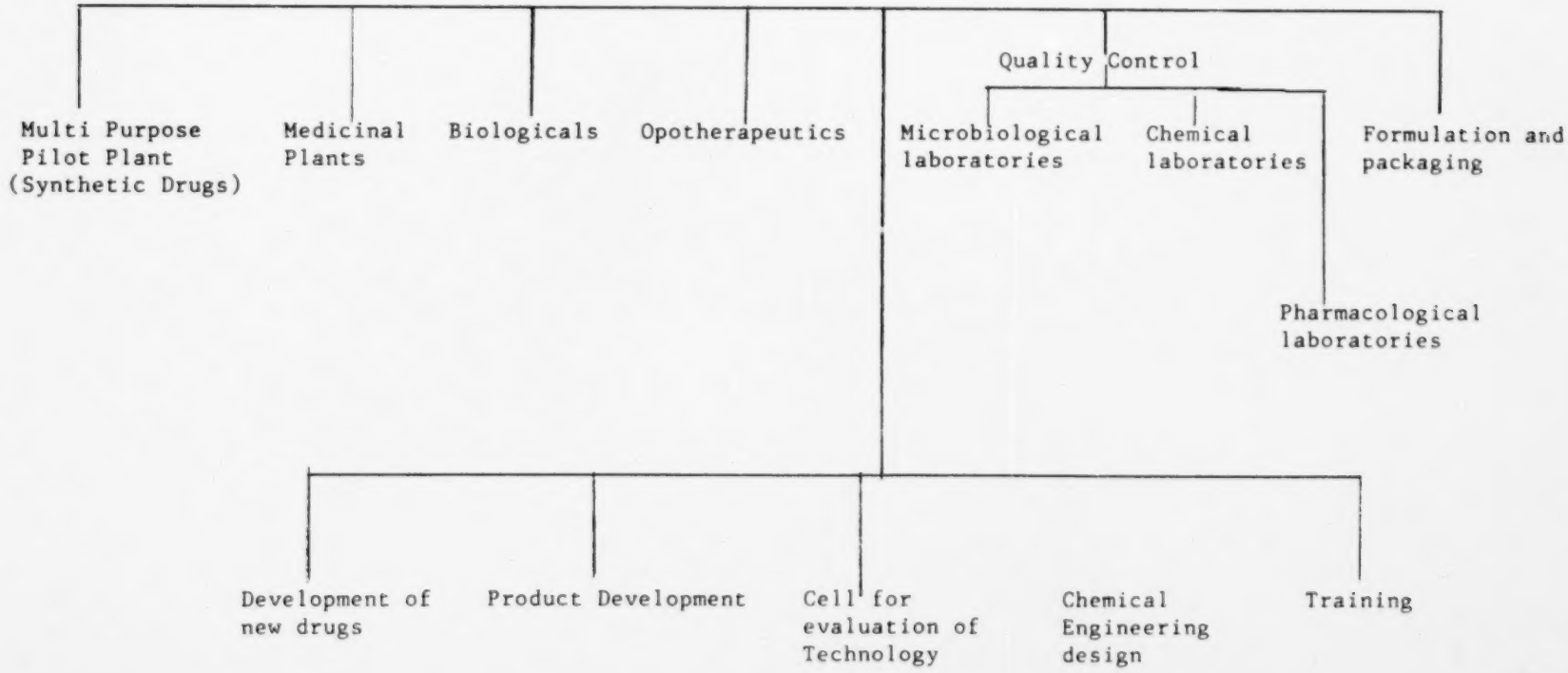
Estimated requirements of Phytochemicals and crude extracts in Arab Countries

* Data based on consumption
** in Sudan

Serial No.	Name of the Chemical or extract	Actual Import in Egypt in kgms	Estimated requirement of Arab countries
1.	Steroidal drugs (corticosteroids, sex hormones)	553.37	1665.00
2.	Codeine salts	2750.1	8250.00
3.	Papaverine salts	2060.28	6180.00
4.	Caffeine salts	10689.77	32067.00
5.	Ergotamine tartarate	81.16	258.00
6.	Ergometrine maleate	7.73	23.00
7.	Hyoscymine sulphate	20.00	60.00
8.	Hyoscine hydrobromide	129.4	388.00
9.	Reserpine	12.70	38.00
10.	Colchicine	7.50	22.00
11.	Digoxine	3.44	10.00
12.	Quinine salts	1049.5	3148.00
13.	Quinidine salts	126.5	379.00
14.	Menthol	2303.9	6911.00
15.	Camphor (natural)	1273.5	3820.00
16.	Camphor (synthetic)	2153.1	6459.00
17.	Thymol	8161.5	24484.00
18.	Euclyptol (cineol)	78.16	234.00
19.*	Pyrethrum extract (23%)	---	5000.00
20.	Euclyptus oil	2303.1	6909.00
21.	Peppermint oil	3800.4	11401.00
22.	Extract Belladona (all types)	8043.00	24129.00
23.	Extract buchu	13125.00	39375.00
24.	Cascara sagrada dry	5000.00	15000.00
25.	Extract gentian	21500.00	69500.00
26.	Extract rhubrab	34990.00	104970.00
27.	Extract senega	23000.00	69000.00
28.	Extract lobelia	5080.00	15210.00
29.	Extract hyoscymus	3140.00	9420.00
30.	Extract Ipec	3854.00	11562.00
31.**	Extract stramonium	---	2000.00
32.	Extract liquorice (liquid)	2700.00	7100.00
33.	Extract liquorice (dry)	2100.00	6340.00
34.	Syrup tolu	16000.00	48000.00

Annex 11

Organizational set-up of Pharmaceutical Industry Research & Development Centre



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THE SITUATION OF NON-METALLIC MINERALS IN DEVELOPING COUNTRIES *

Prepared by

the UNIDO secretariat

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Seen in a historical perspective, the non-metallic minerals were the first to be utilized by the indigenous population of the developing countries, which for the purpose of this paper we shall refer to as one more or less uniform group although, in practice, the picture is a lot more colourful. This was due to their obvious and widespread presence, their ease of mining and their usefulness as building materials and, after a modest transformation, as household utensils. In fact, the shaping of stones into building blocks and the making of simple bricks and pottery were among the very first industries to emerge.

Later, the know-how and skills required to exploit the metallic minerals were developed, and during the course of the colonial age the mining of valuable metals and ores for immediate export became the all-important area of activity while non-metallics were relegated to near oblivion or, at best, a sphere of activity of no economic importance. Industrial processing of any mineral (metallic or non-metallic) was only rarely considered.

When such processing was introduced it was, as a rule, the colonical rulers who took the initiative, since the educated and economically active part of the indigenous population by now had been brought to regard non-metallics with cool indifference. However, the expatriate residents wanting to create for themselves some of "the comforts of home" introduced the first cement manufacturers and aggregate quarries to permit accelerated construction of the accustomed standard and, as it was the case in some Asean countries, set up ceramic industries to be sure of a steady supply of teacups of the required shape and quality.

This was also the time when gradually, and often by coincidence in connection with surveys for metallic ores, economically interesting non-metallic mineral deposits were discovered and their exploitation initiated. But only to be exported as raw materials for industrial processing or consumption abroad. Local processing of minerals such as asbestos, bauxite, graphite and phosphate rock beyond rudimentary concentration is still the exception and large-scale industrialization in certain developing countries is still based on raw materials imported from other developing countries - a violation of the economic interests of <u>both</u> countries involved.

So, while the exploitation of the metalliferous minerals, coal and lately also petroleum resources thrived and eventually also resulted in the establishment of local large-scale processing plants, non-metallics continued to play a marginal role in most national economies. And, as a consequence, the majority of a typical developing country's qualified engineers and geologists were attracted by these large and prestigious mining and processing operations, while the non-metallics sector, struggling for its survival with comparatively few attractions to offer and a dubious future in terms of career development for new staff, was left at the wayside largely unnoticed by young talent.

Even national geological survey departments and other institutions dealing with mineral development failed to understand or recognize the potential of non-metallic minerals development. Or they found it forbiddingly difficult to generate the necessary financial support for extended activities in a sector with few existing industries requiring their services.

Rather a sad picture, one might conclude, leaving little hope for the future. But this was some years ago the situation of a group of minerals whose only common denominators are bulkiness, low cost and the fact that they are "non-metallic", i.e. labelled as not suitable for the metallurgical industry.

Blaming the slow development of this sector on its name alone is, of course, an exaggeration. But words have a curious effect on the minds of people. Just consider the change in attitude which occurs when the very same group of minerals is referred to as "industrial minerals".

When we consider the non-metallic minerals as industrial, or in other words, as necessary raw material inputs to a growing local industry, their importance is obvious and it becomes if not prestigious then at least justifiable from an economic point of view to deal seriously with their development.

This, in very simplified and general terms, is where we stand today. The overwhelming abundance of non-metallic or industrial minerals in the developing countries, both in terms of variety and measured by their shear volume, has been

recognized and their unrivaled potential as a basis for accelerated economic development is being understood by ever widening circles of technical, economic and political decisionmakers.

Few other sectors seem to correspond so well to the criteria defined by the developing countries themselves for an industrial development process appropriate to their resources and needs. These priorities for a reorientation of the industrialization process which were first established at the Second General Conference of UNIDO in Lima, Peru in 1975, and have later been confirmed at a number of similar, gatherings now constitute the basis for UNIDO's involvement in the industrialization process.

A systematic development of the non-metallic mineral-based industries would take advantage of their widespread occurrences even within a given country and give priority to the establishment of small-scale mining operations closely related to adjacent industries producing for the surrounding region. Building Materials such as fired clay bricks and lime cannot economically be transported over longer distances nor can they maintain a competitive price, if the raw materials need to be transported more than a few kilometers. The ideal solution which however, is not always the one preferred, is therefore to establish a number of small decentralized production units near to both raw materials and market. The advantages of low investment cost and easy operation of the small labour-intensive quarries and manufacturing plants are obvious. But also the positive socio-economic effect of building the manufacture on already existing traditions and skills in the region, of providing labour opportunities to the local population and of producing for the benefit of local consumption should not be neglected.

Very few metalliferous mineral processing industries offer the same easy and inexpensive start-up conditions as do the non-metallic mineral-based industries which lend themselves very well to a small-scale labour-intensive approach. They consequently provide a very attractive sector for a developing country in its early stages of industrialization, and it is reassuring to note that this is now being realized by an ever increasing number of planners both in the developing countries and in the industrialized countries with which they co-operate.

However, apart from industries using cheap, bulky raw materials for which the low ratio of value to weight makes transport excessively expensive and import impossible, a surprisingly large proportion of non-metallic raw materials for processing in developing countries is still being imported from abroad. There may, of course, be very good reasons for such an import such as when a glass factory finds it necessary to import not only soda ash but also the glass sand itself because local sand is too rich in iron oxides and heavy mineral contaminations to be beneficiated and delivered to the plant at a price competitive with imported high quality glass sand. In other cases the reasons behind raw material importation are not so well founded and a switch to the use of local resources at least a theoretical possibility.

But the practical implementation of such a replacement of imported raw materials by local ones and the establishment of new non-metallic mineral-based industries producing for import substitution is, unfortunately, a process with many obstacles. In the following, we shall briefly consider their nature and how they may be overcome.

A basic problem of many countries is that the domestic non-metallic mineral resources, although recorded by various general geological surveys through the years, have never been the subject of detailed qualitative and quantitative exploration. Any serious industrial exploitation must therefore in its earliest planning stages find a way to verify the existence of the necessary raw materials. And often the whole project stops here since neither the public authorities or the potential investor can mobilize the necessary funds, especially in view of the risk that the outcome of the exploration might be negative. In other words, there is a need to engage larger amounts of public funds or technical assistance funds in the verification of economically exploitable non-metallic mineral deposits. This important ground work, which must be carried out in order to generate interest from investors must be planned on the basis of a careful analysis of present mineral imports as well as new interesting application or export possibilities and at the same time limit itself to sites with relatively easy access.

Once a given deposit has been thoroughly studied it is still too early to expect prospective users to cue up for a mining licence. This is typical for non-metallic quarrying operations that the preparatory work weights heavily on the overall investment budget and private, especially foreign investors, would normally be reluctant to even consider investing in the opening and development of the mine or quarry without a well-defined quarry legislation. Although the UN stands ready to provide the necessary advice such legislation takes time to formulate and pass through the administrative machinery and attractive investment propositions may quickly vanish if the Government has not had the foresight to bring the legal side of mineral exploitation in order before launching a non-metallic mineral development scheme.

Another problem which might make a potential investor in an industrial undertaking or an already existing industry using at least partly imported raw materials hesitate or refuse to use a well documented and economically exploitable local raw material could be quality specifications below international standards or possibly just a fear that the quality could be below a comfortably high level. This reaction is understandable but, unfortunately, not very conducive to a steady development of the domestic non-metallic minerals sector. UNIDO knows several examples from its co-operation with developing countries of so-called low quality raw materials which after some beneficiation or adjustment of the user industry's processing technology yielded perfectly acceptable products and resulted in important foreign savings for the national economy. If, for instance, a ceramics manufacture composes its earthenware body of imported kaolin, quartz and feldspar, it requires some courage but pays handsomely off to switch to a local primary deposit of weathered granite which from nature has a kaolin/quartz/feldspar ratio which only needs minor adjustments to suit the technological requirements of the production.

It is not only the traditional respect for the "safe" imported raw materials with guaranteed chemical and physical specifications which make industries in many developing countries prefer this expensive solution. Often it is the lack of adequate local research and development facilities including equipment as well as trained and motivated staff capable of verifying the industrial potential of domestic non-metallic mineral resources and developing technologies corresponding to the raw material characteristics and the real requirements of the market.

The establishment of a national laboratory with both analytical capacity and the know-how and equipment to carry out technology development work in close co-operation with on the one hand the geological survey department and on the other the potential user industries or institutions responsible for planning and promoting new industries should be high on the priority list of developing countries with recorgnized potential for a broad range of non-metallic industries based on domestic resources.

The institutional affiliations of such a "non-metallic minerals development center" and its sources of financing may differ widely from country to country but experience seems to show that only with a sound national support function of this kind it is possible to achieve a rapid development in the non-metallic minerals sector.

To break the dependence on imported minerals and technologies, not to mention dependence on imported finished products which could have been locally manufactured, is a task very few developing countries are capable of fulfilling entirely on their own. This is what technical co-operation is all about!

Other countries have already gone through the same process and have gained their experiences, often painful but mostly, in the end, rewarding. And today this experience which was acquired over many years is available to the developing world in various forms which it might be useful to consider briefly at this point.

The classical form of technical assistance with its emphasis on missions of shorter or longer duration carried out by experts primarily coming from industrialized countries is still the dominating source of technology transfer to developing countries. By and large, it is an efficient way of introducing new ideas for non-metallic minerals utilization and for promoting the implementation of development and investment projects. This type of assistance, however, suffers from the relatively high cost of international consultants which, under the constraint of limited financing possibilities, reduces the number and scope of possible co-operation acitivities.

On this background, the concept of twinning arrangements between institutions involved in similar activities as, for instance, the development of the non-metallic minerals sector, has evolved. The twinning between two geological surveys or two research and development institutes in different countries implies a long-term agreement covering exchange of information and experience both directly through mutual visits or indirectly through reports or research papers. Several institutions in the industrialized countries are now prepared to enter into this kind of co-operation.

However, even more relevant to the solution of the problems prevailing in a developing country is the experience gained in another developing country, and a south-south twinning arrangement or, in other words, Technical Co-operation among Developing Countries (TCDC) is therefore today considered as the most cost-effective way of raising a country's technological level in keeping with its needs and resources.

To apply these resources in a way resulting in the optimum socio-economic development of the developing countries is by no means a simple task if the overall situation is considered. If, on the other hand, attention is focused on the non-metallic minerals sector as this paper has done, albeit in a very brief and general form, it is obvious that more financial resources, national as well as international, invested in the development of domestic mining and processing operations would be one of the most promising ways of accelerating the exploitation of the enormous wealth of non-metallic mineral resources for the benefit of the developing countries and their peoples.